USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: The Relationship Between Soil Test Phosphorus Levels and Phosphorus in Surface Runoff in Manure Amended Soils: A Rainfall Simulator Study

Project Category: Research/Education/Extension

Principal Investigators: Dr. Gary M. Pierzynski, Dr. Gary Clark

Project Duration: March 1, 1999 to February 28, 2001

Federal Funds Requested: $40,141

Non-federal Funds Pledged: $93,072

Key Words: Phosphorus, Runoff, Soil, Manure

Statement of Critical State Water Problem

Despite media and research attention on pesticides, nitrates, and other surface water and groundwater contaminants, phosphorus (P) remains a significant threat to the quality of Kansas surface waters. Nearly all Kansas lakes and streams are considered severely impacted by P based on total P concentrations in the water. A significant proportion of this P comes from surface runoff with a large majority of the runoff attributable to agricultural lands. A recent study of Big Bull Creek watershed in eastern Kansas estimated that 80-95% of the P load came from nonpoint sources. Phosphorus contributes to eutrophication of surface water bodies and is characterized by frequent algal blooms, low dissolved oxygen concentrations, low species diversity, taste and odor problems, and impairment of recreational and navigational activities. These concerns were recently acknowledged by the Kansas Legislature in passing House Bill No. 2950 (HB2950) which provided regulations for large confined animal feeding operations and mandated nutrient management plans for such operations. The plans stipulate that the operations must provide an adequate land base for land application of animal waste such that the P holding capacity of the soils not be exceeded within five years. Unfortunately, no technical information was provided on the definition of P holding capacity. Researchers at Kansas State University, following the lead of scientists in other states facing this same dilemma, utilized the relationship between soil test P levels and soluble P concentrations in runoff as a guide. The relationship suggests that soil test P levels of approximately 100 mg P/kg (using the Bray-1 test) produce soluble P concentrations in runoff of approximately 1 mg/liter and this concentration corresponds to the upper limit of acceptable levels based on allowable discharges from waste water treatment facilities. The data base for this relationship is small and consists almost exclusively of studies utilizing inorganic commercial P fertilizers as a P source rather than animal wastes. In Kansas, soil test P levels are more likely to approach 100 mg/kg as a result of land application of animal wastes than from the use of inorganic commercial P fertilizers.

Nature, scope, and objectives of the proposed work

Our objective is to determine the relationship between soil test P levels and total, dissolved, and bioavailable P in surface runoff from manure amended soils. This relates directly to the Objectives of the State Water Plan for significantly increasing the percentage of stream miles and lake acres which fully support their designated uses as identified in the Kansas Surface Water Quality Standards. This would be accomplished by reducing the proportion of said stream miles and lake acres impacted by excessive nutrient concentrations. In addition, the proposed work will increase the scientific basis for using soil test P levels to determine the maximum allowable P loadings from animal wastes as has been done in other states and in Kansas for HB2950. A better understanding of the relationship between soil test P and P in runoff allows for more accurate predictions of the impact of various land use practices on surface water quality. The previously mentioned Big Bull Creek watershed drains into Hillsdale Reservoir where a proposed total maximum daily loading (TMDL) level for P would require a 46% reduction in nonpoint source P inputs. It is difficult to estimate how changes in land use practices and characteristics, including soil test P levels, would reduce nonpoint source P inputs.